

SPERM WHALE (*Physeter macrocephalus*): Hawaiian Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

Sperm whales are found in tropical to polar waters throughout the world (Rice 1989). Sperm whales are widely distributed across the entire North Pacific and into the southern Bering Sea in summer but the majority are thought to be south of 40°N in winter (Rice 1974, 1989; Gosho et al. 1984; Miyashita et al. 1995). For management, the International Whaling Commission (IWC) had divided the North Pacific into two management regions (Donovan 1991) defined by a zig-zag line which starts at 150°W at the equator, is 160°W between 40-50°N, and ends up at 180°W north of 50°N; however, the IWC has not reviewed this stock boundary in many years (Donovan 1991). Summer/fall surveys in the eastern tropical Pacific (Wade and Gerrodette 1993) show that although sperm whales are widely distributed in the tropics, their relative abundance tapers off markedly westward towards the middle of the tropical Pacific (near the IWC stock boundary at 150°W) and tapers off northward towards the tip of Baja California. The Hawaiian Islands marked the center of a major nineteenth century whaling ground for sperm whales (Gilmore 1959; Townsend 1935). Since 1936, at least five strandings have been reported from Oahu, Kauai (Nitta 1991) and Kure Atoll (Woodward 1972). Sperm whales have also been sighted around several of the Northwestern Hawaiian Islands (Rice 1960), off the main island of Hawaii (Lee 1993; Mobley et al. 1999, see Figure 1), in the Kauai Channel and in the Alenuihaha Channel between Maui and the island of Hawaii (Shallenberger 1981). In addition, the sounds of sperm whales have been recorded throughout the year off Oahu (Thompson and Friedl 1982).

The stock identity of sperm whales in the North Pacific has been inferred from historical catch records (Bannister and Mitchell 1980) and from trends in CPUE and tag-recapture data (Ohsumi and Masaki 1977), but much uncertainty remains. A 1997 survey designed specifically to investigate stock structure and abundance of sperm whales in the northeastern temperate Pacific revealed no apparent hiatus in distribution between the U.S. EEZ off California and areas farther west, out to Hawaii (Barlow and Taylor 1998). Very preliminary genetic analyses revealed significant differences between sperm whales off the coast of California, Oregon and Washington and those sampled offshore to Hawaii (Mesnick et al., unpubl. data); analyses of additional genetic samples are ongoing at the NMFS, Southwest Fisheries Science Center. For the Marine Mammal Protection Act (MMPA) stock assessment reports, sperm whales within the Pacific U.S. EEZ are divided into three discrete, non-contiguous areas: 1) waters around Hawaii (this report), 2) California, Oregon and Washington waters, and 3) Alaskan waters.

POPULATION SIZE

Gosho et al. (1984) summarized IWC estimates of "initial" (1910) and "current" (1982) stock sizes for sperm whales in the North Pacific based on a CPUE model. Wade and Gerrodette (1993) estimated 22,700 sperm whales for the eastern tropical Pacific from data collected on ship line-transect surveys. Forney et al. (1995) estimated 892 sperm whales in California waters during winter/spring. However, there are no data available for estimating the number of sperm whales in Hawaiian waters. A large 1982 abundance estimate for the entire eastern North Pacific (Gosho et al. 1984) was based on a CPUE method which is no longer accepted as valid by the International Whaling Commission. Recently, a combined visual and acoustic line-transect survey conducted in the eastern temperate North Pacific in spring 1997 resulted in estimates of 24,000 (CV=0.46) sperm whales based on visual sightings, and 39,200 (CV=0.60) based acoustic detections and visual group size estimates (Barlow and Taylor 1998). In the eastern tropical Pacific,

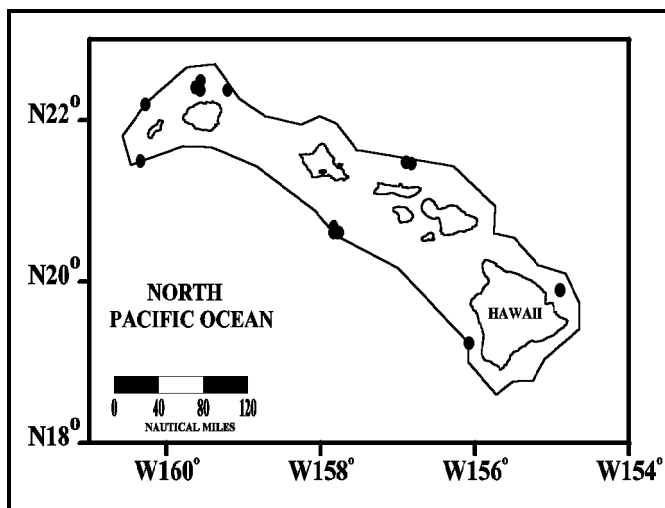


Figure 1. Sperm whale sighting locations during 1993-98 aerial surveys within about 25 nmi of the main Hawaiian Islands (see Appendix 2 for details on timing and location of survey effort). Outer line indicates approximate boundary of survey area.

the abundance of sperm whales has been estimated as 22,700 (95% C.I.=14,800-34,600; Wade and Gerrodette 1993). However, it is not known whether any or all of these animals routinely enter the U.S. EEZ of Hawaii. As part of the Marine Mammal Research Program of the Acoustic Thermometry of Ocean Climate (ATOC) study, a total of twelve aerial surveys were conducted within about 25 nmi of the main Hawaiian Islands in 1993, 1995 and 1998. An average abundance estimate of 66 (CV=0.56) sperm whales was recently calculated from the combined survey data (Mobley et al. 1999). This abundance underestimates the total number of sperm whales within the U.S. EEZ off Hawaii, because areas around the Northwest Hawaiian Islands (NWHI) and beyond 25 nautical miles from the main islands were not surveyed. Furthermore, this species is known to spend a large proportion of time diving, causing additional downward bias in the abundance estimate.

Minimum Population Estimate

~~No data are available to make a minimum population estimate.~~ The log-normal 20th percentile of the combined 1993-98 abundance estimate is 43 sperm whales. As with the best abundance estimate above, this includes only areas within about 25 nmi of the main Hawaiian Islands and does not include a large proportion of animals that were diving and therefore unavailable to be seen.

Current Population Trend

No data on current population trend are available.

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

No data on current or maximum net productivity rate are available.

POTENTIAL BIOLOGICAL REMOVAL

~~No PBR can be calculated for this stock at this time.~~ The potential biological removal (PBR) level for this stock is calculated as the minimum population size (43) times one half the default maximum net growth rate for cetaceans ($\frac{1}{2}$ of 4%) times a recovery factor of 0.50 (for a species of unknown status with no known fishery mortality; Wade and Angliss 1997), resulting in a PBR of 0.4 sperm whales per year.

~~ANNUAL~~ HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

Fishery Information

No estimate of annual human-caused mortality and serious injury is available as there are no reports of recent direct or incidental takes of sperm whales in Hawaiian waters (Nitta and Henderson 1993). However, mortality of other cetacean species has been observed in Hawaiian fisheries, and the gear types used in these fisheries are responsible for marine mammal mortality and serious injury in other fisheries throughout U.S. waters. Gillnets are used in Hawaiian waters and appear to capture marine mammals wherever they are used, and float lines from lobster traps and longlines can be expected to occasionally entangle whales (Perrin et al. 1994).

~~Pelagic, bottomfish and lobster fisheries occur in Hawaiian waters. Pelagic fisheries include commercial fisheries (troll, handline, longline, local inshore gillnet), commercial charter and recreational troll fishing. Only the longline fishery is subject to active management through a Fishery Management Plan. The growth of the longline fleet between 1989 and 1991 generated concerns regarding impact on fish stocks (especially swordfish), on other fisheries (troll, handline), and on protected species (mainly sea turtles). The value of longline landings increased to almost \$45 million in 1992 and 1993. Regulations established longline fishery permit and reporting requirements, area closures in the Northwestern Hawaiian Islands (NWHI) to protect Hawaiian monk seals and in the main Hawaiian Islands to prevent gear conflicts, a limited entry program, a mandatory observer program, and a requirement for installation and operation of vessel monitoring equipment on longline vessels in Hawaii. Approximately 165 longline permits have been issued. The commercial non-longline fisheries (troll, handline, gillnet) have more than 2,000 participants but account only for about \$10-\$15 million per year in landings. The number of anglers and value of recreational fishing are unknown.~~

Interactions with dolphins are reported for all pelagic fisheries, and humpback whales have been entangled in longlines off the Hawaiian Islands (Nitta and Henderson 1993), but no takes of sperm whales have been documented. None were observed hooked in the Hawaiian longline fishery between 1994 and 1998, with approximately 4.4% of all effort (measured as the number of hooks fished) observed (Kleiber 1999).

~~The commercial lobster fishery in the NWHI is managed by federal regulations which include size limits, area closures, seasons, gear restrictions, annual quotas and reporting requirements. Fifteen permits have been issued for this fishery. The fishery was closed in 1993 and only five vessels operated in the fishery in 1994. No interactions~~

between marine mammals and this fishery have been recorded in the past five years.

The bottomfish fishery occurs throughout the NWHI and the main Hawaiian Islands using handlines. In the NWHI, there are two zones in which fishing takes place. The Ho'omalulu Zone has limited entry and the Maui Zone has open access. There are currently 11 permits for the Ho'omalulu Zone and 30 for the Maui Zone. However, in 1994, only five vessels fished in the Ho'omalulu Zone and 15-20 vessels fished in the Maui Zone. Total landings of bottomfish in Hawaii from all waters have fluctuated little in recent years, about 400,000 pounds per year from the NWHI and about 500,000 pounds per year from the main Hawaiian Islands. Fishermen claim interactions with dolphins who steal bait and catch are increasing.

Historical Mortality

Sperm whales were exploited throughout their range in the North Pacific and equatorial Pacific during the nineteenth century (see Tillman and Donovan 1983). Approximately 268,972 sperm whales were killed by modern whaling operations in the North Pacific from 1910 to 1976 (Ohsumi 1980). Between 1800 and 1909, about 60,842 sperm whales were estimated taken in the North Pacific (Best 1976). The reported take of North Pacific sperm whales by commercial whalers between 1947 and 1987 totaled 258,000 (C. Allison, pers. comm.). Factory ships operated as far south as 20°N (Ohsumi 1980). Ohsumi (1980) lists an additional 28,198 sperm whales taken mainly in coastal whaling operations from 1910 to 1946. Based on the massive under-reporting of Soviet catches, Brownell et al. (1998) estimate that about 89,000 whales were additionally taken by the Soviet pelagic whaling fleet between 1949 and 1979. The Japanese coastal operations apparently also under-reported catches by an unknown amount (Kasuya 1998). Thus a total of at least 436,000 sperm whales were taken between 1800 and the end of commercial whaling for this species in 1987. Of this grand total, an estimated 33,842 were taken by Soviet and Japanese pelagic whaling operations in the eastern North Pacific from the longitude of Hawaii to the U.S. West coast, between 1961 and 1976 (Allen 1980, IWC statistical Areas II and III), and 965 were reported taken in land-based U.S. West coast whaling operations between 1947 and 1971 (Ohsumi 1980). In addition, 13 sperm whales were taken by shore whaling stations in California between 1919 and 1926 (Clapham et al. 1997). There has been a prohibition on taking sperm whales in the North Pacific since 1988, but large-scale pelagic whaling stopped earlier, in 1980. Pelagic whaling for sperm whales in the North Pacific ended after the 1979 season (IWC 1981), and coastal whaling for this species ended after the 1988 season (IWC 1989). Some of the whales taken during the whaling era were certainly from a population or populations that occur within Hawaiian waters.

Fishery Mortality Rate

The total fishery mortality and serious injury cannot be considered to be insignificant and approaching zero because the population size of this stock of sperm whales is unknown. Determination cannot be made for individual fisheries until the implementing regulations for section 118 of the Marine Mammal Protection Act have been reviewed by the public and finalized.

STATUS OF STOCK

The only estimate of the status of North Pacific sperm whales in relation to carrying capacity (Gosho et al. 1984) is based on a CPUE method which is no longer accepted as valid. The status of sperm whales in Hawaiian waters relative to OSP is unknown, and there are insufficient data to evaluate trends in abundance. The stock's status relative to OSP under the MMPA is also unknown. The species is listed as endangered under the U.S. Endangered Species Act (1973); therefore, the Hawaiian stock is classified as a strategic stock according to the 1994 amendments to the MMPA. Sperm whales are formally listed as "endangered" under the Endangered Species Act (ESA), and consequently the Hawaiian stock is automatically considered as a "depleted" and "strategic" stock under the MMPA. The total fishery mortality and serious injury for sperm whales is zero and therefore can be considered to be insignificant and approaching zero mortality and serious injury rate. The increasing levels of anthropogenic noise in the world's oceans has been suggested to be a habitat concern for whales, particularly for deep-diving whales like sperm whales that feed in the oceans' "sound channel".

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